FOREST INSECT AND DISEASE MANAGEMENT / evaluation report

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Effectiveness of Three Formulations of Dimilin® in Suppressing the Gypsy Moth

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Introduction

The aerial application of chemical insecticides to suppress high-density populations of the gypsy moth, *Lymantria dispar* (L.) (Lepidoptera: Lymantriidae), has historically included the use of the chemical insecticides DDT,[1] Dylox,® and Sevin®.[2] Due to recent emphasis on the development of insecticides which are effective both in suppressing gypsy moth populations and are environmentally compatible, attention has focused on testing a class of chemicals called growth regulators.

One such growth regulator, Dimilin® (diflubenzuron), which inhibits chitin biosynthesis, has been evaluated in the laboratory (McLane 1974) and in the field (Herbaugh and McLane 1974, 1975, 1976; Herbaugh et al. 1975; Law 1975; Reardon et al. 1975). In 1976, the Environmental Protection Agency (EPA) registered a wettable powder formulation—25 percent active ingredient (W-25) of Dimilin at 34 to 67 g a.i./9.35 liter/ha for use in suppressing the gypsy moth.

The Thompson-Hayward Chemical Company located in Kansas City, Kansas has recently developed two oil formulations of Dimilin which when aerially applied may enhance the effectiveness of Dimilin as a contact insecticide, reduce evaporation during application and provide more uniform coverage than that of the W-25 formulation. One oil formulation, oil dispersible—25 percent active ingredient (OD-25)—consists of a wettable powder which is mixed with No. 2 fuel or crop oil. This suspension formulation differs from the other oil formulation, oil flowable soluble powder (3.3 oil), which contains emulsifiers which form a solution.

This study was designed to evaluate the effectiveness of these two oil formulations of Dimilin when applied at registered application dosages (34 to 67 g a.i./ha) in a reduced volume (2.3 liter/ha) against the wettable powder formulation (W-25) when applied at two application times (early and conventional)[3] and dosages (11 or 34 g a.i./ha) in the registered volume (9.35 liter/ha).[4]

Materials and Methods

The studies were conducted over two years on 21 blocks, each 14 ha, distributed over several ridges with northern red, chestnut and white oaks, (*Quercus rubra* L., *Q. prinus* L., *Q. alba* L.) comprising over 70 percent of the dominant tree species on Bald Eagle and Tiadaughton State Forests, Pennsylvania. To minimize edge effect, a subblock of 10 ha from which data collections were made was established within each 14-ha block. In 1976, efficacy data were collected from 10 plots, each 0.01 ha, within each of 12 subblocks; in 1977, these data were collected from a fixed- and variable-radius plot system established within each of 9 subblocks (Wilson and Fontaine 1978). Treatments and controls were replicated 3 times.

The specific parameters monitored in the .01-ha plots and the fixed and variable-radius plots were:

1. Egg-mass density: Determined before and after treatment by counting the number of egg masses visible at 3 levels—ground, tree bole, and crown.

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[1]DDT has not been used against the gypsy moth since 1968.

[2]The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Since use does not constitute official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

[3]Conventional timing is achieved by the application of spray material when 75 percent of the host larvae were in 2nd and 3rd instars and white oak foliage 50 to 70 percent expanded.

[4]The work herein reported was funded in whole or in part by a U.S. Department of Agriculture sponsored program entitled "The Expanded Gypsy Moth Research and Development Program."

2. Egg viability: Determined by examining 20 egg masses collected within each subblock in early March and late October. Equal quantities of egg masses were collected above and below the snow line. The percent hatch was recorded for viable eggs.

3. Larval density: Determined from 10-minute counts of larvae made at 3-day intervals along 3 transect lines in each subblock.

4. Defiolation: Estimated visually (1 percent increments) before and after treatment for each tree larger than 3 inches in diameter at breast height.

5. Spray characterization: Spray deposit data were obtained and assessed with white Kromekote® cards placed in card holders spaced at 22-m intervals along 3 established lines in each block.

In 1976, all materials were applied from Grumman Agcats® equipped with standard spray booms. The W-25 and 3.3 oil formulations were sprayed from Flat Fan Teejet® nozzles (Model 8004). The early timing application of the W-25 formulation was made when 75 percent of the host larvae were 1st and 2nd instars and expansion of white oak foliage was 0 to 5 percent. The conventional timing applications of the W-25 and 3.3 oil formulations were made when 75 percent of the host larvae were 2nd and 3rd instars and expansion of white oak foliage was 50 to 70 percent.

The W-25 formulation was applied once at a rate of 11 g a.i./9.35 liter/ha. The Animal and Plant Health Inspection Service (APHIS) evaluated the W-25 formulation of Dimilin at an application rate of 67 g a.i./9.35 liter/ha in the same geographical area (Herbaugh and McLane 1976); thus there was an opportunity to compare the two application rates. One conventional timing application of the 3.3 oil was made at a rate of 67 g a.i./2.3 liter/ha. In 1977, all formulations were applied from a Cessna Agtruck® equipped with a standard spray boom and Flat Fan Teejet nozzles (Model 8004). The OD-25 oil formulation was applied once at a rate of 35 g a.i./9.35 liter/ha and the W-25 water formulation was applied once at a rate of 34 g a.i. liter/ha. Conventional application timing was used for both formulations.

Results

In 1976, the 3.3 oil formulation applied at conventional timing and the W-25 water formulation applied at early and conventional timings provided excellent protection of foliage (an average net increase in defoliation of 17 percent in the white oak group compared to 87 percent for controls) (Table 1). Foliage protection was not significantly different (5 percent level) among treatments. There were no significant differences in viability of egg masses among treated and control blocks. The number of egg masses/0.4 ha in the control blocks increased from 1,610 to 2,630 (Table 2).

Population reduction based on egg mass counts and larval mortality before and after treatment was not significantly (5% level) different between the conventional timing application of the W-25 water and 3.3 oil formulations, although it was significantly (8% level) greater than that for the early timing application of the W-25 water formulation (Table 2, Fig. 1).

Larval mortality was apparent in all Dimilin-treated blocks from 5 to 7 days after application, with a 98 percent reduction in number of larvae evident by 30 days in all treated blocks except those receiving an early application. The protection of foliage and population reduction afforded by the W-25 water formulation applied at 67 g a.i./9.35 liter/ha was comparable to that of the W-25 formulation at 11 g a.i./9.35 liter/ha (Herbaugh and McLane 1976). Operational difficulty was encountered with

Table 1.—*Protection afforded to white oak group foliage—1976-1977*

Treatment	Application timing	Percent defoliation		Defoliation increase	Percent foliage[ab] protection
		Before treatment	After treatment		
		1976			
W-25	Early	10	29	19	68
W-25	Standard	8	28	20	67
3.3 oil	Standard	17	30	13	74
Control	—	12	99	87	—
		1977			
W-25	Standard	14	25	11	49
OD-25	Standard	14	28	14	46
Control	—	11	71	60	—

[a] By definition, foliage protection is achieved when refoliation is prevented. Refoliation, specifically in oaks, occurs when a tree or portions of it are more than 50 percent defoliated.
[b] Net control defoliation minus net treatment defoliation.

Table 2.—*Number of gypsy moth egg masses per 0.4 ha before- and after-treatment*

Treatment	Before treatment (masses/0.4 ha)	After treatment (masses/0.4 ha)	Percent decrease
	1976		
W-25 early	1,516	1,220	20
W-25 standard	1,616	164	90
3.3 oil standard	3,239	20	99
Control	1,610	2,630	+39
	1977		
W-25 standard	3,970	20	99
OD-25 standard	4,278	93	98
Control	1,455	2,293	+37

the 3.3 oil formulation. The material did not pour easily from the storage and shipment containers, and was viscid in the mixing tank.

In 1977, the OD-25 and W-25 formulations provided excellent foliage protection (average net increase in defoliation of 12.5 percent in the white oak group compared to 60 percent for controls) (Table 1). The number of egg masses/0.4 ha in the control blocks increased from 1,455 to 2,293 (Table 2). There were no significant differences (5 percent level) between the OD-25 and W-25 formulations based on egg mass counts and larval mortality before and after treatment (Table 2, Fig. 2). The difficulty in mixing the 3.3 oil formulation in 1976 was not encountered with the OD-25 formulation in 1977. The OD-25 formulation upon agitation in the mixing tank reached suspension within an acceptable 5- to 10-minute period.

Figure 1.—Larval density as determined by 10-minute larval counts—1976.

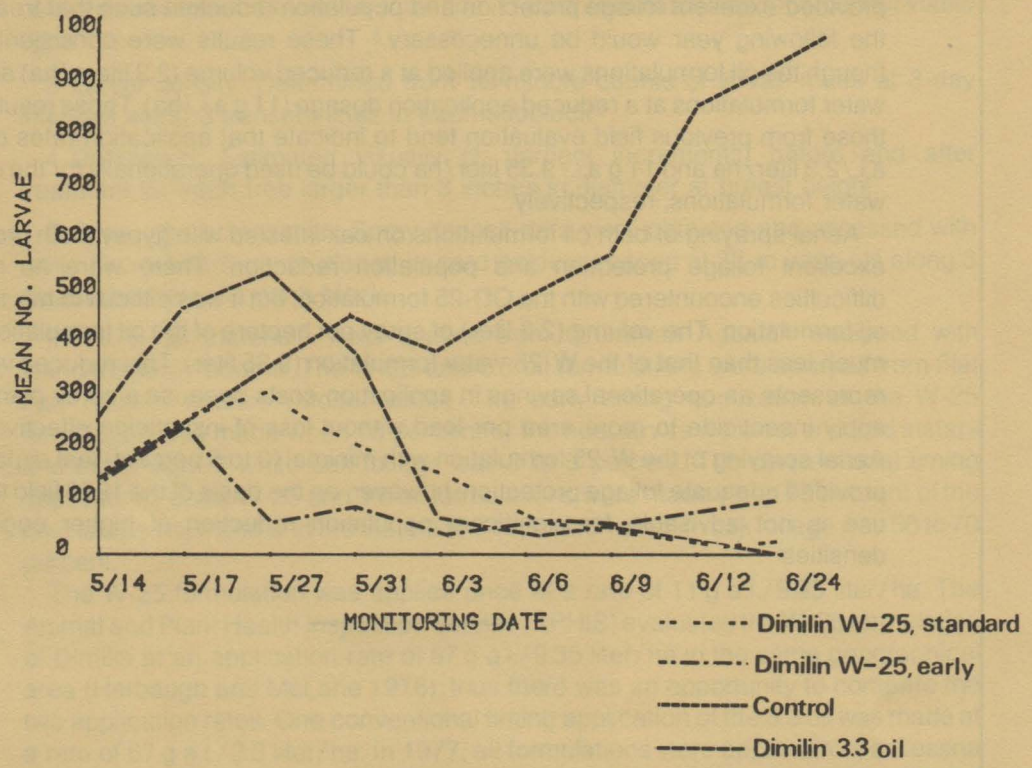
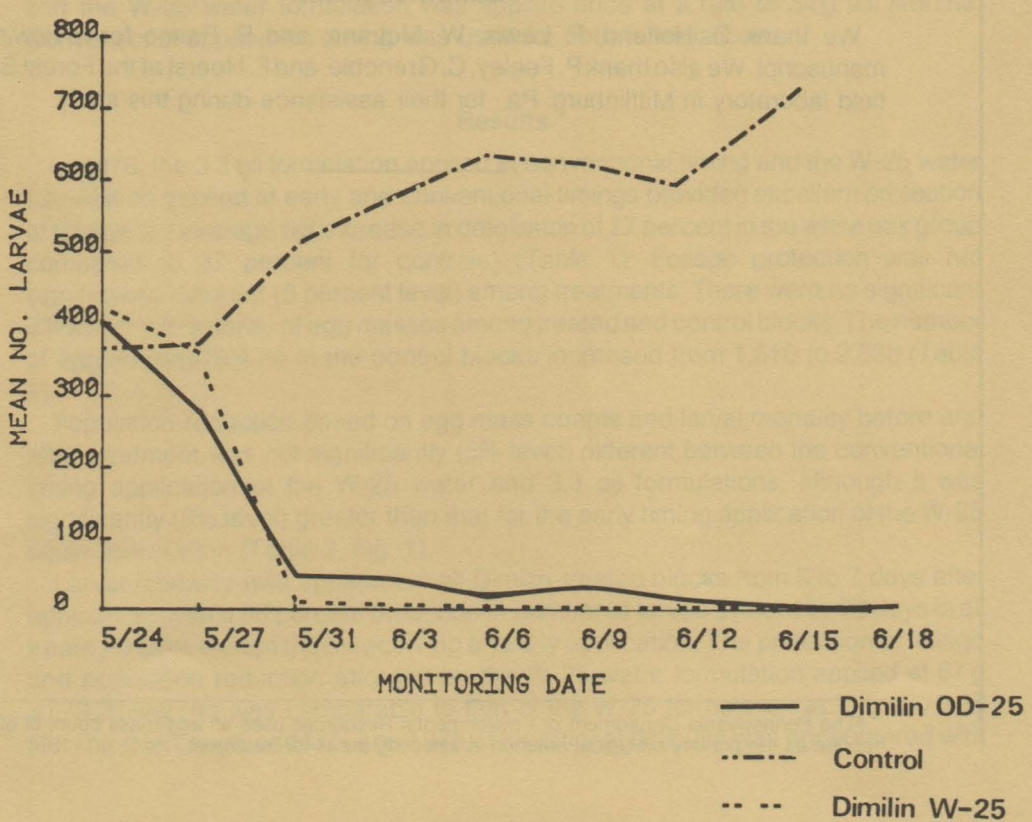


Figure 2.—Larval density as determined by 10-minute larval counts—1977.



Discussion

The conventional timing applications of the oil and water fomulations of Dimilin provided excellent foliage protection and population reduction such that treatment the following year would be unnecessary.[5] These results were consistent even though the oil formulations were applied at a reduced volume (2.3 liters/ha) and the water formulations at a reduced application dosage (11 g a.i./ha). These results and those from previous field evaluation tend to indicate that application rates of 34 g a.i./2.3 liter/ha and 11 g a.i./9.35 liter/ha could be used operationally for the oil and water formulations, respectively.

Aerial spraying of both oil formulations on oak infested with gypsy moth provided excellent foliage protection and population reduction. There were no mixing difficulties encountered with the OD-25 formulation, but it was difficult to mix the 3.3 oil formulation. The volume (2.3 liter) of spray per hectare of the oil formulation was much less than that of the W-25 water formulation (9.35 liter). This reduced volume represents an operational savings in application costs because a spray plane can apply insecticide to more area per load without loss of insecticide effectiveness. Aerial spraying of the W-25 formulation with minimal (0 to 5 percent) leaf expansion provided adequate foliage protection; however, on the basis of the 1976 field test, its use is not advisable for significant population reduction at higher egg-mass densities.

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[5]The Pennsylvania Department of Environmental Resources uses an egg-mass count of 625 per hectare as the primary biological criterion in selecting areas for treatment.

References

Herbaugh, L. L., and W. H. McLane.
1974. Field evaluation of Dimilin. Semi-annual laboratory report (July-December). USDA Anim. Plant Health Insp. Serv., Otis Air Force Base, Mass. 31 p.

Herbaugh, L. L., and W. H. McLane.
1975. 1975 field evaluation of candidate insecticides for gypsy moth control. Semi-annual laboratory report (July-December). USDA Anim. Plant Health Insp. Serv., Otis Air Force Base, Mass. 13 p.

Herbaugh, L. L., and W. H. McLane.
1976. 1976 field evaluation of Dimilin. Semi-annual laboratory report (July-December). USDA Anim. Plant Health Insp. Serv., Otis Air Force Base, Mass. 7 p.

Herbaugh, L. L., W. H. McLane, and C. R. Stacy.
1975. Field evaluation of insecticides against the gypsy moth. Semi-annual laboratory report (July-December). USDA Anim. Plant Health Insp. Serv., Otis Air Force Base, Mass. 16 p.

Law, K.
1975. Field evaluation of the effects of Dimilin on honey bees and the efficacy of population control of gypsy moth. N.J. Dep. Agric. Div. Plant Ind., Trenton, N.J. 7 p.

McLane, W. H.
1974. Laboratory evaluation of Dimilin. Semi-annual laboratory report (July-December). USDA Anim. Plant Health Insp. Serv., Otis Air Force Base, Mass. 7 p.

Reardon, R. C., D. G. Holland, and A. S. Munson.
1975. Effectiveness of a growth regulator and selected biological methods in suppressing the gypsy moth. USDA For. Serv. Northeast Area, State Priv. For., Broomall, PA. 14 p.

Wilson, R. W., Jr., and G. A. Fontaine.
1978. Gypsy moth egg-mass sampling with fixed- and variable-radius plots. USDA, Agric. Handb. 523, Washington, DC. 46 p.

Pesticide Precautionary Statement

This publication reports evaluations involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.